



(12) **United States Patent**
Jandhyala et al.

(10) **Patent No.:** **US 10,120,856 B2**
(45) **Date of Patent:** **Nov. 6, 2018**

(54) **RECOGNITION OF FIELDS TO MODIFY IMAGE TEMPLATES**

(71) Applicant: **International Business Machines Corporation**, Armonk, NY (US)

(72) Inventors: **Srinivas Jandhyala**, Hyderabad (IN); **Krishnan P. Rajagopalan**, Bangalore (IN)

(73) Assignee: **International Business Machines Corporation**, Armonk, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/928,112**

(22) Filed: **Oct. 30, 2015**

(65) **Prior Publication Data**

US 2017/0124059 A1 May 4, 2017

(51) **Int. Cl.**

G06F 17/24 (2006.01)
G06F 3/0484 (2013.01)
G06T 7/00 (2017.01)
G06F 17/27 (2006.01)

(52) **U.S. Cl.**

CPC **G06F 17/248** (2013.01); **G06F 3/0484** (2013.01); **G06F 17/243** (2013.01); **G06F 17/278** (2013.01); **G06T 7/0085** (2013.01)

(58) **Field of Classification Search**

CPC G06F 17/243
USPC 715/221–226
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,886,136 B1 4/2005 Zlotnick et al.
7,809,615 B2 * 10/2010 Hui G06Q 10/067
705/34
8,160,865 B1 * 4/2012 Coughlan G06F 17/248
704/4
2007/0154098 A1 * 7/2007 Geva G06F 17/243
382/209
2007/0168382 A1 * 7/2007 Tillberg G06F 17/30253
2009/0254803 A1 * 10/2009 Bayne G06F 17/243
715/222
2013/0230246 A1 9/2013 Nuggehalli

* cited by examiner

Primary Examiner — Keith D Bloomquist

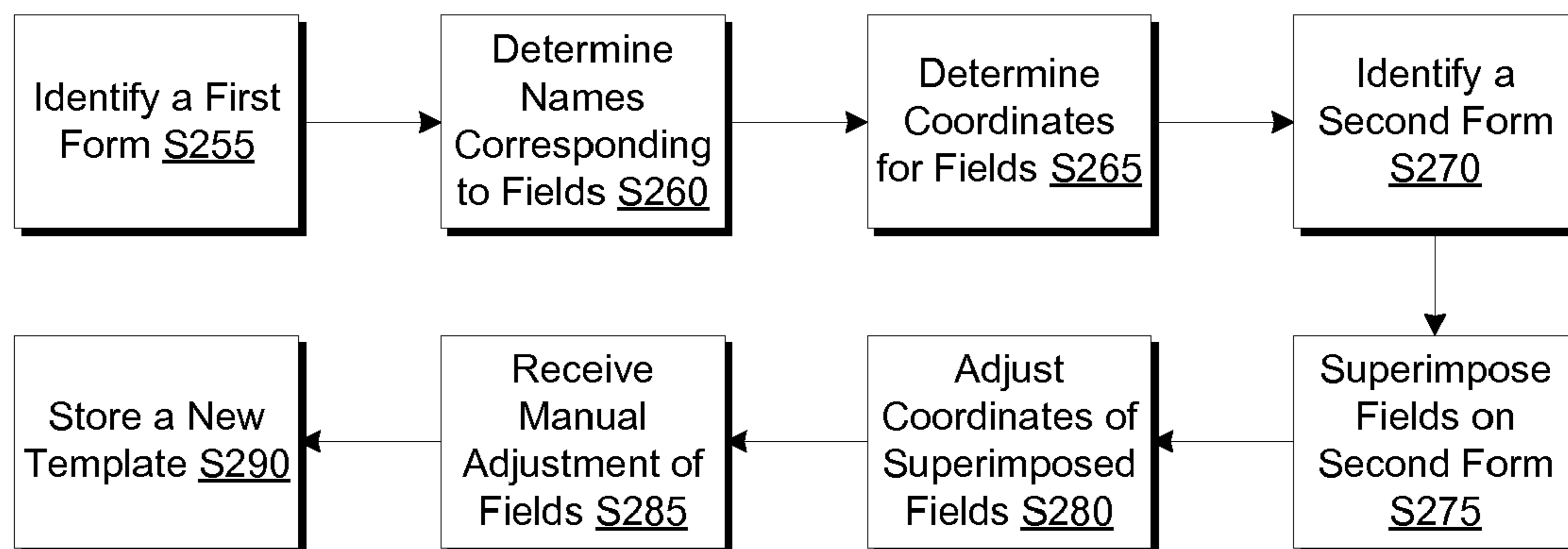
(74) *Attorney, Agent, or Firm* — Peter J. Hackmann

(57) **ABSTRACT**

Modifying image templates based on recognition of fields (zones). A template is created based on a first form and, upon application of the template to a second form, fields of the template are modified to align with fields of the second form.

20 Claims, 5 Drawing Sheets

250



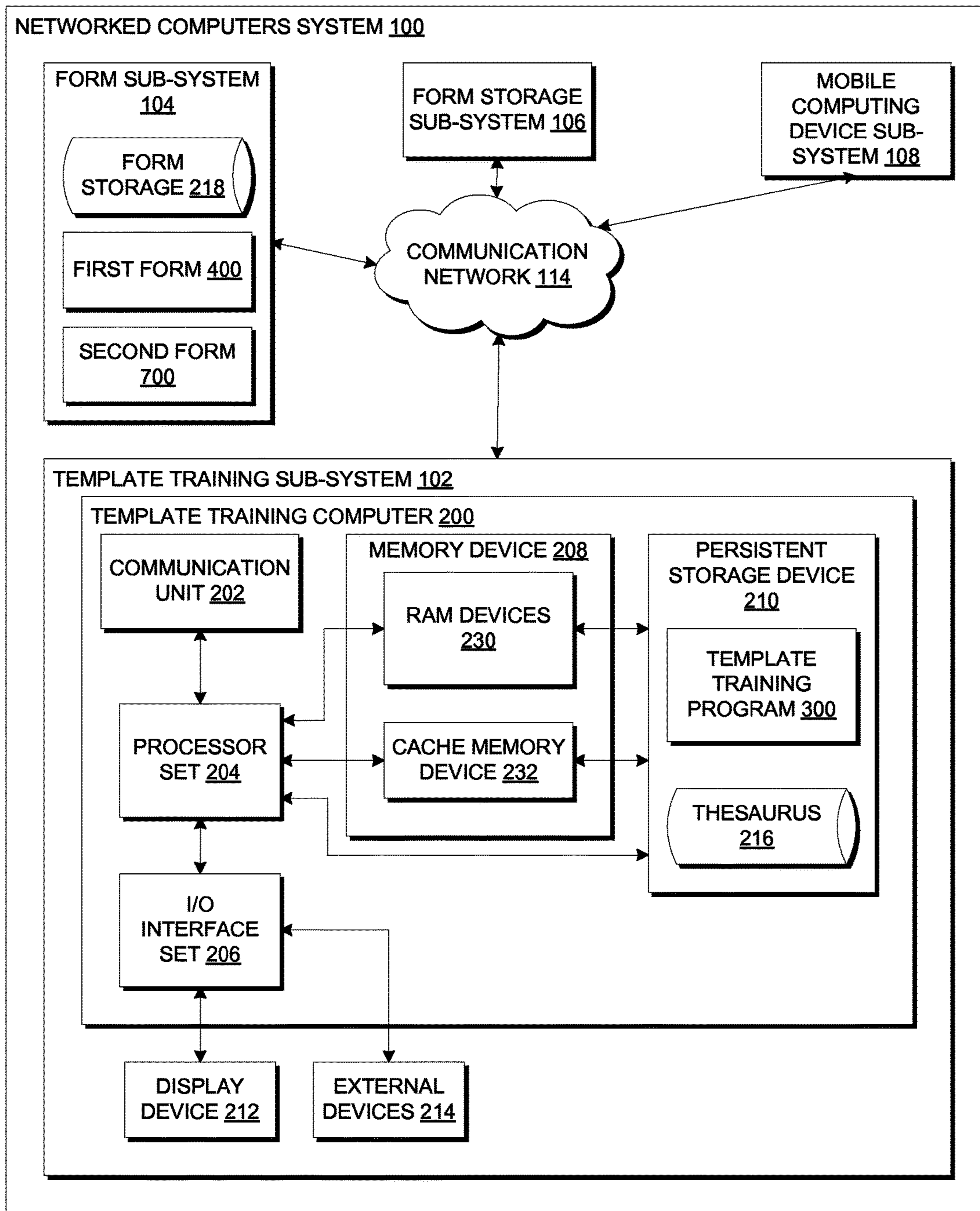


Fig. 1

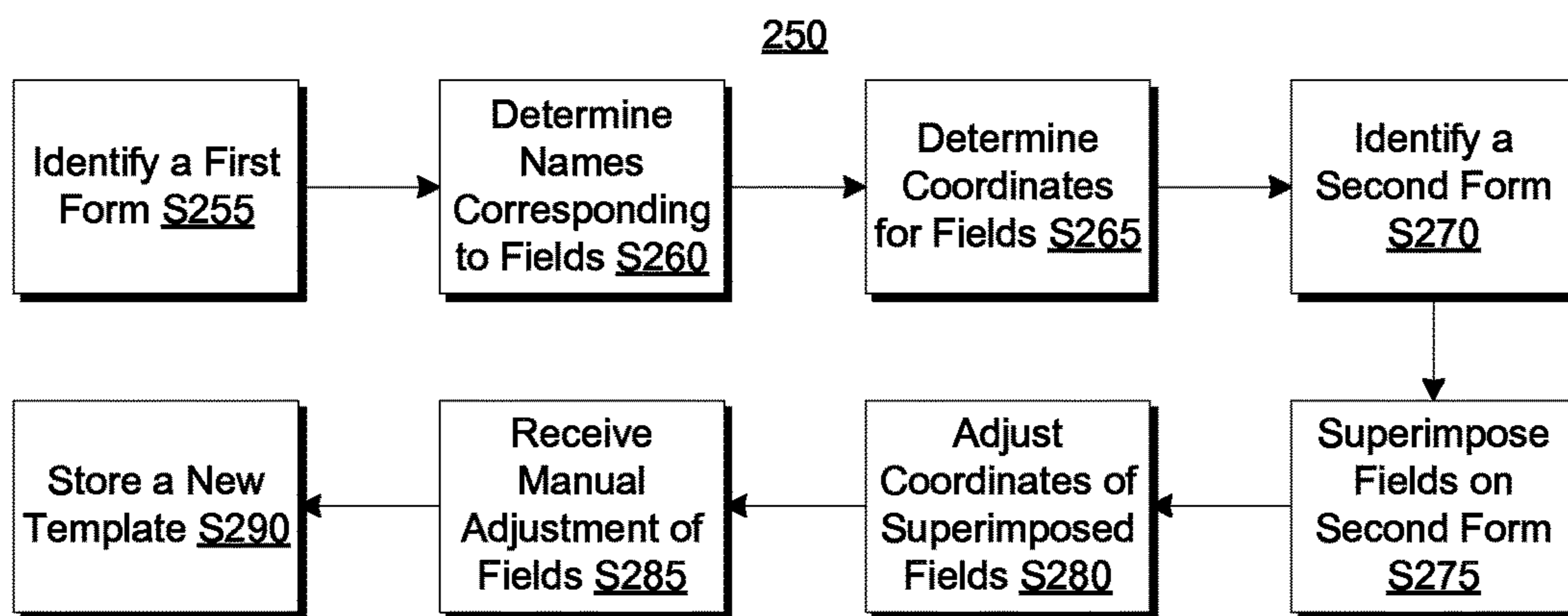


Fig. 2

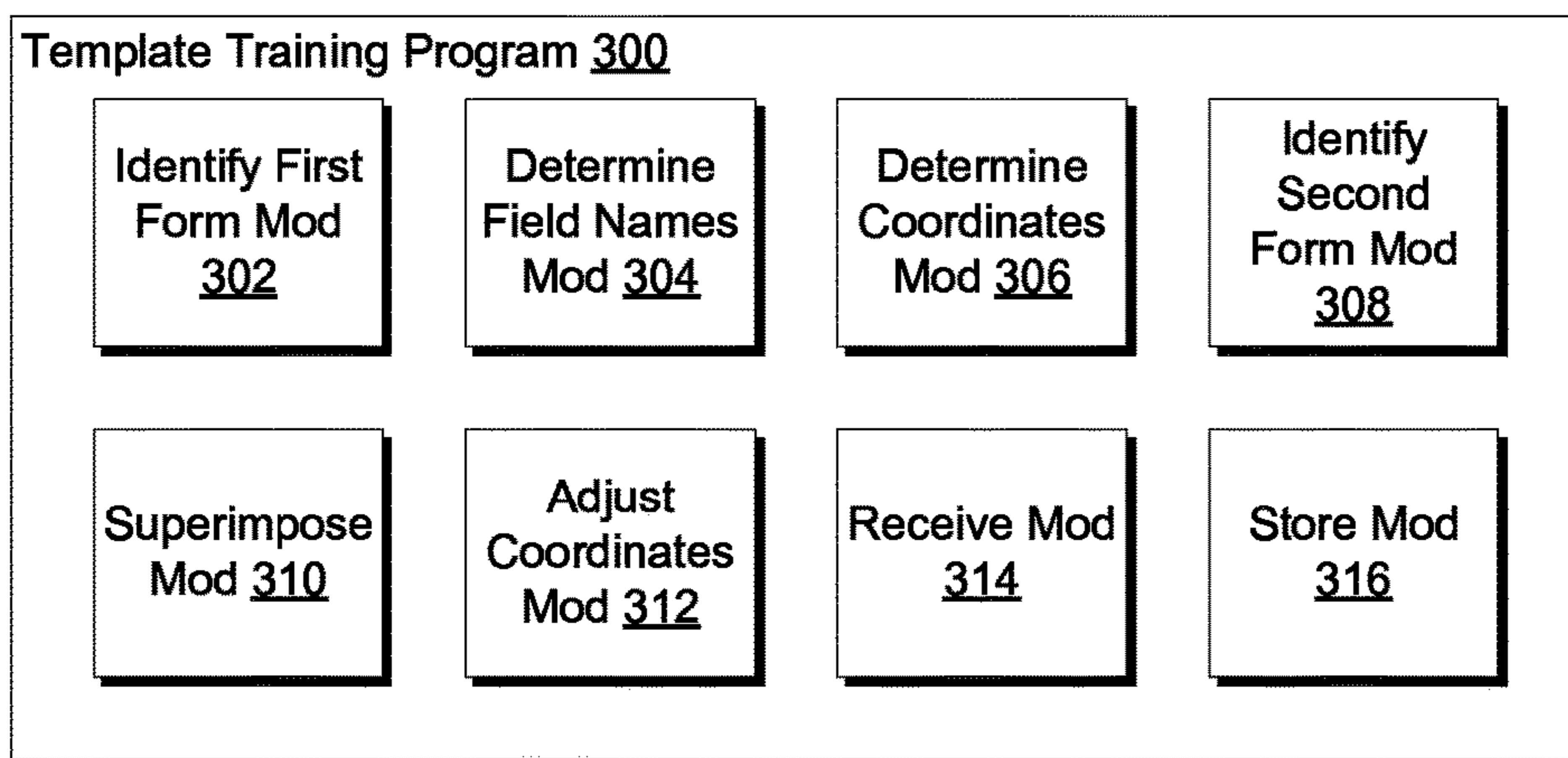


Fig. 3

400

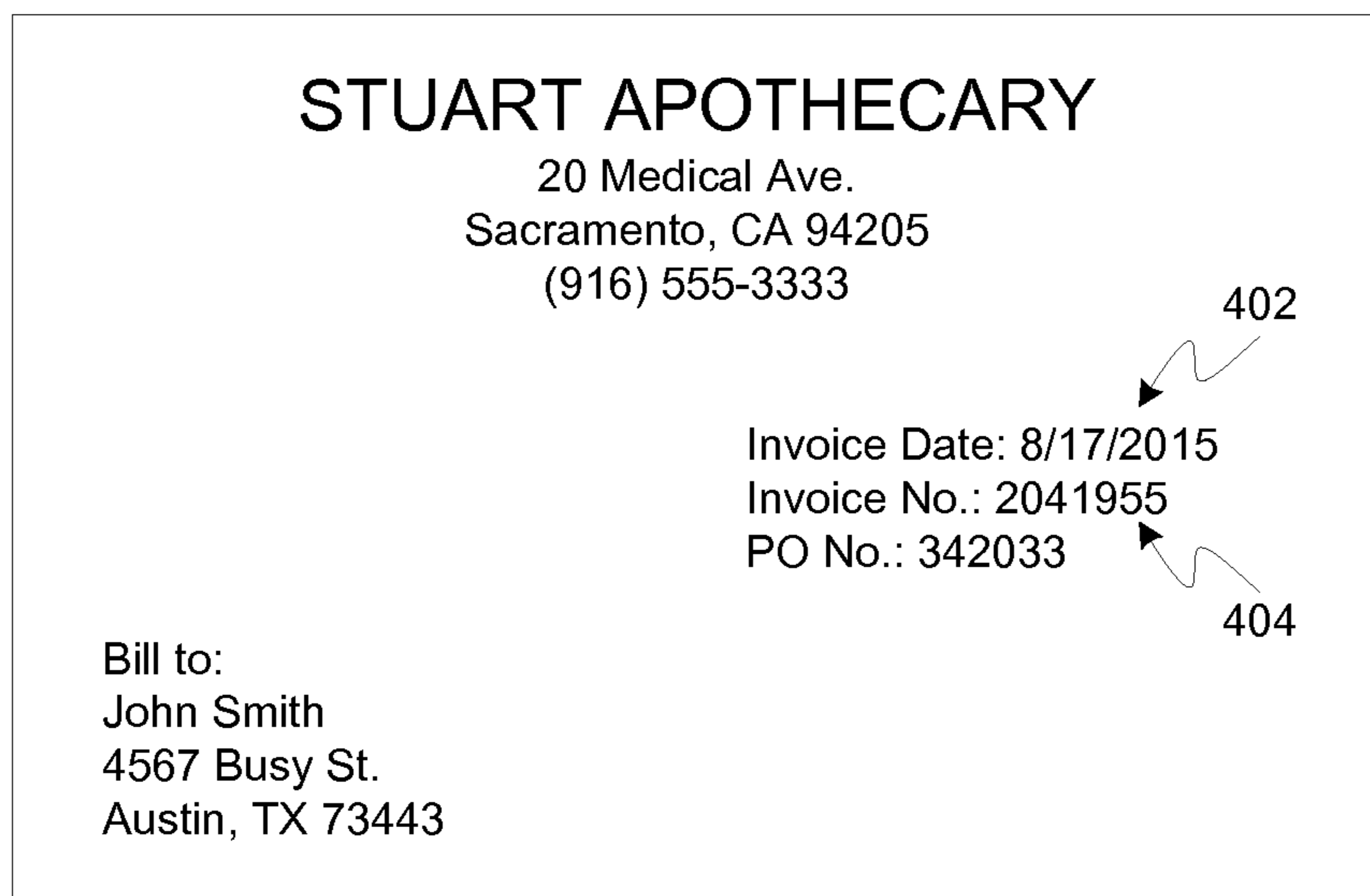


Fig. 4

500

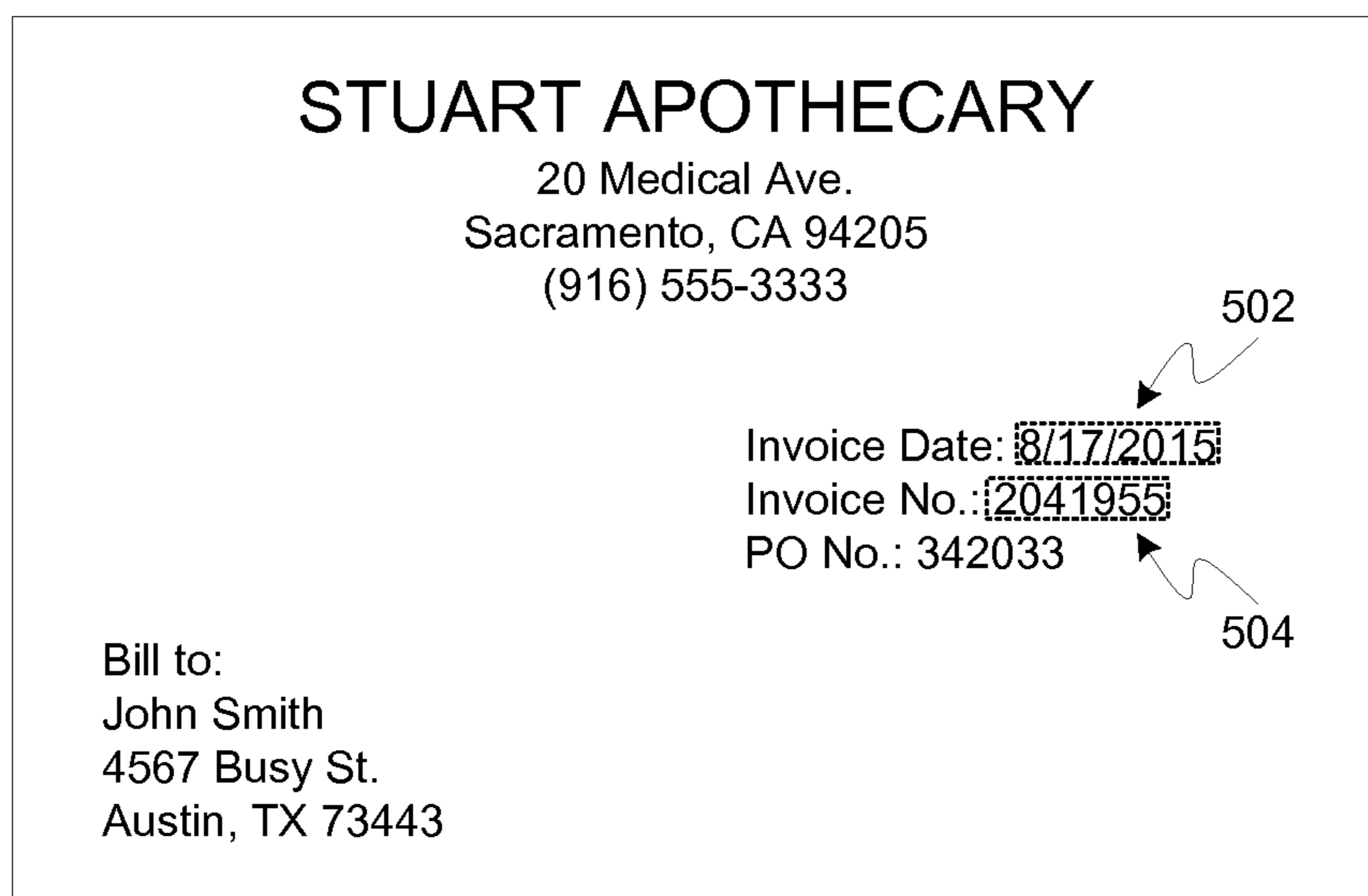


Fig. 5

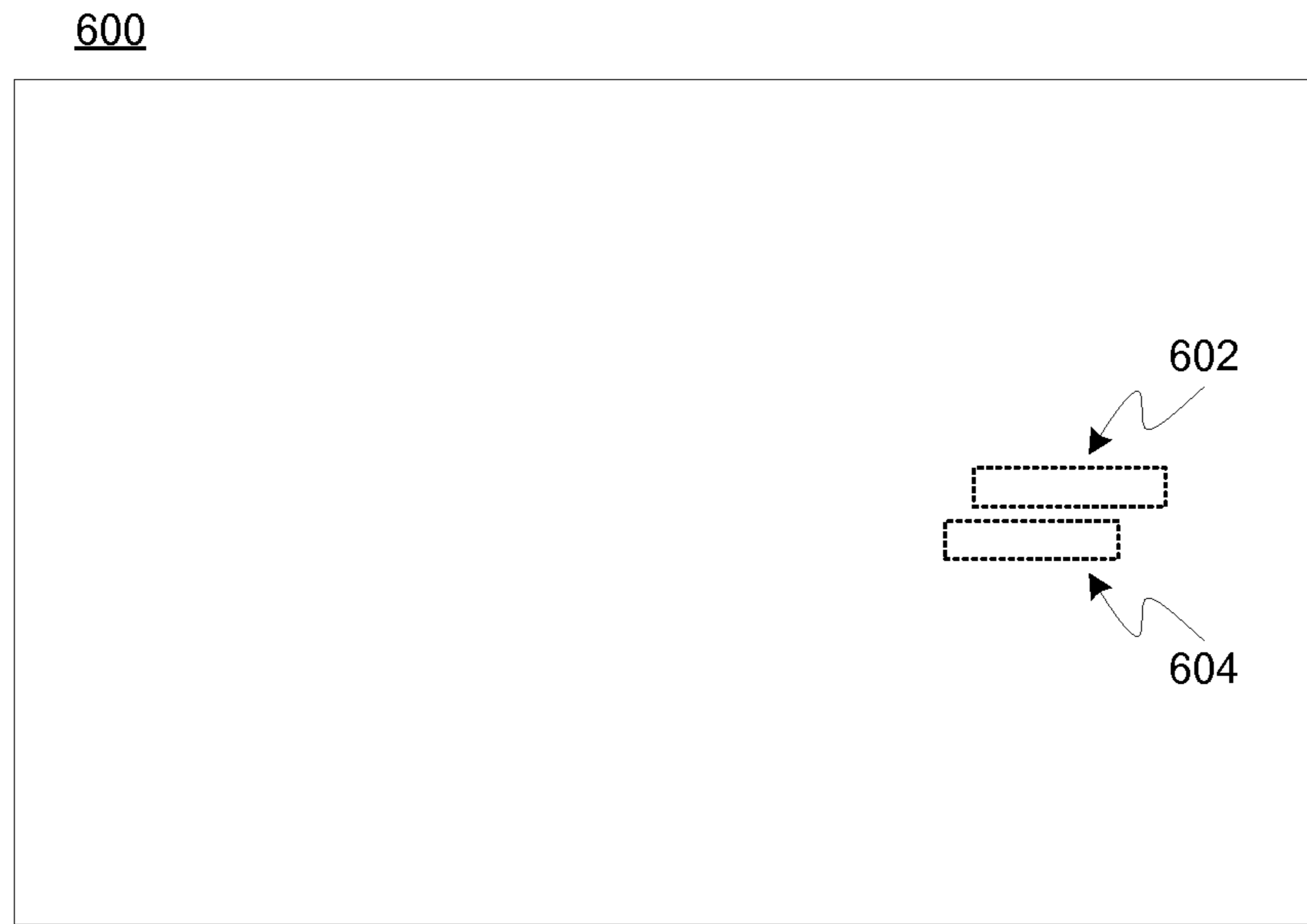


Fig. 6



Fig. 7

800



Fig. 8

900



Fig. 9

RECOGNITION OF FIELDS TO MODIFY IMAGE TEMPLATES

BACKGROUND

The present invention relates generally to the field of image analysis, and more particularly to template matching.

Image recognition products capture content from an image. Some image recognition products employ a template. Some of templates are trained to improve performance (trained templates). Using trained templates to capture content is sometimes also called zonal optical character recognition (OCR). Zonal OCR relies on a set of zones (fields), each of which can be visualized as a bounding rectangle on an image. A field can be represented as a set of pixel coordinates, which are used to retrieve the content from an image. Because various documents include similar fields having various placements, various trained templates are required to properly analyze each document. Each trained template must be manually created. A trained template can have ten or more fields and there can be hundreds of trained templates, depending on how a system is used. Manual entry of hundreds or thousands of fields is time consuming, repetitive, and error prone.

SUMMARY

According to an aspect of the present invention, there is a method, computer program product, and/or system that performs the following operations (not necessarily in the following order): (i) determining a set of coordinates for a set of first fields on a first form; (ii) superimposing a set of second fields on a second form based, at least in part, on the set of coordinates for the set of first fields; and (iii) adjusting a set of coordinates for the set of second fields. At least determining the set of coordinates for the set of first fields on the first form is performed by computer software running on computer hardware.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram view of a first embodiment of a system according to the present invention;

FIG. 2 is a flowchart showing a first embodiment method performed, at least in part, by the first embodiment system;

FIG. 3 is a block diagram view of a machine logic (e.g., software) portion of the first embodiment system;

FIG. 4 depicts a screenshot of a first form according to a second embodiment of the present invention;

FIG. 5 depicts a screenshot of a first coordinates form according to some embodiments of the present invention;

FIG. 6 depicts a screenshot of a form skin according to some embodiments of the present invention;

FIG. 7 depicts a screenshot of a second form according to some embodiments of the present invention;

FIG. 8 depicts a screenshot of a masked form according to some embodiments of the present invention; and

FIG. 9 depicts a screenshot of a second coordinates form according to some embodiments of the present invention.

DETAILED DESCRIPTION

Modifying image templates based on recognition of fields (zones). A template is created based on a first form and, upon application of the template to a second form, fields of the template are modified to align with fields of the second form. This Detailed Description section is divided into the follow-

ing sub-sections: (i) Hardware and Software Environment; (ii) Example Embodiment; (iii) Further Comments and/or Embodiments; and (iv) Definitions.

I. Hardware and Software Environment

The present invention may be a system, a method, and/or a computer program product at any possible technical detail level of integration. The computer program product may include a computer readable storage medium (or media) having computer readable program instructions thereon for causing a processor to carry out aspects of the present invention.

The computer readable storage medium can be a tangible device that can retain and store instructions for use by an instruction execution device. The computer readable storage medium may be, for example, but is not limited to, an electronic storage device, a magnetic storage device, an optical storage device, an electromagnetic storage device, a semiconductor storage device, or any suitable combination of the foregoing. A non-exhaustive list of more specific examples of the computer readable storage medium includes the following: a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a static random access memory (SRAM), a portable compact disc read-only memory (CD-ROM), a digital versatile disk (DVD), a memory stick, a floppy disk, a mechanically encoded device such as punch-cards or raised structures in a groove having instructions recorded thereon, and any suitable combination of the foregoing. A computer readable storage medium, as used herein, is not to be construed as being transitory signals per se, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide or other transmission media (e.g., light pulses passing through a fiber-optic cable), or electrical signals transmitted through a wire.

Computer readable program instructions described herein can be downloaded to respective computing/processing devices from a computer readable storage medium or to an external computer or external storage device via a network, for example, the Internet, a local area network, a wide area network and/or a wireless network. The network may comprise copper transmission cables, optical transmission fibers, wireless transmission, routers, firewalls, switches, gateway computers and/or edge servers. A network adapter card or network interface in each computing/processing device receives computer readable program instructions from the network and forwards the computer readable program instructions for storage in a computer readable storage medium within the respective computing/processing device.

Computer readable program instructions for carrying out operations of the present invention may be assembler instructions, instruction-set-architecture (ISA) instructions, machine instructions, machine dependent instructions, microcode, firmware instructions, state-setting data, configuration data for integrated circuitry, or either source code or object code written in any combination of one or more programming languages, including an object oriented programming language such as Smalltalk, C++, or the like, and procedural programming languages, such as the "C" programming language or similar programming languages. The computer readable program instructions may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the

remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider). In some embodiments, electronic circuitry including, for example, programmable logic circuitry, field-programmable gate arrays (FPGA), or programmable logic arrays (PLA) may execute the computer readable program instructions by utilizing state information of the computer readable program instructions to personalize the electronic circuitry, in order to perform aspects of the present invention.

Aspects of the present invention are described herein with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer readable program instructions.

These computer readable program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. These computer readable program instructions may also be stored in a computer readable storage medium that can direct a computer, a programmable data processing apparatus, and/or other devices to function in a particular manner, such that the computer readable storage medium having instructions stored therein comprises an article of manufacture including instructions which implement aspects of the function/act specified in the flowchart and/or block diagram block or blocks.

The computer readable program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other device to cause a series of operational steps to be performed on the computer, other programmable apparatus or other device to produce a computer implemented process, such that the instructions which execute on the computer, other programmable apparatus, or other device implement the functions/acts specified in the flowchart and/or block diagram block or blocks.

The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods, and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of instructions, which comprises one or more executable instructions for implementing the specified logical function(s). In some alternative implementations, the functions noted in the blocks may occur out of the order noted in the Figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems

that perform the specified functions or acts or carry out combinations of special purpose hardware and computer instructions.

An embodiment of a possible hardware and software environment for software and/or methods according to the present invention will now be described in detail with reference to the Figures. FIG. 1 is a functional block diagram illustrating various portions of networked computers system **100**, including: template training sub-system **102**; form sub-system **104**; form storage sub-system **106**; mobile computing device sub-system **108**; and communication network **114**. Template training sub-system **102** contains: template training computer **200**; display device **212**; and external devices **214**. Template training computer **200** contains: communication unit **202**; processor set **204**; input/output (I/O) interface set **206**; memory device **208**; and persistent storage device **210**. Memory device **208** contains: random access memory (RAM) devices **230**; and cache memory device **232**. Persistent storage device **210** contains: thesaurus **216**; and template training program **300**. Form sub-system **104** contains: form storage **218**; first form **400**; and second form **700**.

Template training sub-system **102** is, in many respects, representative of the various computer sub-systems in the present invention. Accordingly, several portions of template training sub-system **102** will now be discussed in the following paragraphs.

Template training sub-system **102** may be a laptop computer, a tablet computer, a netbook computer, a personal computer (PC), a desktop computer, a personal digital assistant (PDA), a smart phone, or any programmable electronic device capable of communicating with client sub-systems via communication network **114**. Template training program **300** is a collection of machine readable instructions and/or data that is used to create, manage, and control certain software functions that will be discussed in detail, below, in the Example Embodiment sub-section of this Detailed Description section.

Template training sub-system **102** is capable of communicating with other computer sub-systems via communication network **114**. Communication network **114** can be, for example, a local area network (LAN), a wide area network (WAN) such as the Internet, or a combination of the two, and can include wired, wireless, or fiber optic connections. In general, communication network **114** can be any combination of connections and protocols that will support communications between template training sub-system **102** and client sub-systems.

Template training sub-system **102** is shown as a block diagram with many double arrows. These double arrows (no separate reference numerals) represent a communications fabric, which provides communications between various components of template training sub-system **102**. This communications fabric can be implemented with any architecture designed for passing data and/or control information between processors (such as microprocessors, communications processors, and/or network processors, etc.), system memory, peripheral devices, and any other hardware components within a system. For example, the communications fabric can be implemented, at least in part, with one or more buses.

Memory device **208** and persistent storage device **210** are computer readable storage media. In general, memory device **208** can include any suitable volatile or non-volatile computer readable storage media. It is further noted that, now and/or in the near future: (i) external devices **214** may be able to supply some, or all, memory for template training

sub-system **102**; and/or (ii) devices external to template training sub-system **102** may be able to provide memory for template training sub-system **102**.

Thesaurus **216** is a storage that includes various field names and/or potential alternative field names. As depicted in FIG. 1, thesaurus **216** exists within persistent storage device **210**. Thesaurus **216** can also be located within any other sub-system connected to communication network **114**.

Form storage **218** is a storage that includes various forms. A set of forms within form storage **218** are trained templates. Form storage **218** contains first form **400**. As depicted in FIG. 1, form storage **218** exists within form sub-system **104**. Form storage **218** can also be located within any other sub-system connected to communication network **114**.

Template training program **300** is stored in persistent storage device **210** for access and/or execution by one or more processors of processor set **204**, usually through memory device **208**. Persistent storage device **210**: (i) is at least more persistent than a signal in transit; (ii) stores the program (including its soft logic and/or data) on a tangible medium (such as magnetic or optical domains); and (iii) is substantially less persistent than permanent storage. Alternatively, data storage may be more persistent and/or permanent than the type of storage provided by persistent storage device **210**.

Template training program **300** may include both substantive data (that is, the type of data stored in a database) and/or machine readable and performable instructions. In this particular embodiment (i.e., FIG. 1), persistent storage device **210** includes a magnetic hard disk drive. To name some possible variations, persistent storage device **210** may include a solid-state hard drive, a semiconductor storage device, a read-only memory (ROM), an erasable programmable read-only memory (EPROM), a flash memory, or any other computer readable storage media that is capable of storing program instructions or digital information.

The media used by persistent storage device **210** may also be removable. For example, a removable hard drive may be used for persistent storage device **210**. Other examples include optical and magnetic disks, thumb drives, and smart cards that are inserted into a drive for transfer onto another computer readable storage medium that is also part of persistent storage device **210**.

Communication unit **202**, in these examples, provides for communications with other data processing systems or devices external to template training sub-system **102**. In these examples, communication unit **202** includes one or more network interface cards. Communication unit **202** may provide communications through the use of either or both physical and wireless communications links. Any software modules discussed herein may be downloaded to a persistent storage device (such as persistent storage device **210**) through a communications unit (such as communication unit **202**).

I/O interface set **206** allows for input and output of data with other devices that may be connected locally in data communication with template training computer **200**. For example, I/O interface set **206** provides a connection to external devices **214**. External devices **214** will typically include devices, such as a keyboard, a keypad, a touch screen, and/or some other suitable input device. External devices **214** can also include portable computer readable storage media, such as, for example, thumb drives, portable optical or magnetic disks, and memory cards. Software and data used to practice embodiments of the present invention (e.g., template training program **300**) can be stored on such portable computer readable storage media. In these embodi-

ments, the relevant software may (or may not) be loaded, in whole or in part, onto persistent storage device **210** via I/O interface set **206**. I/O interface set **206** also connects in data communication with display device **212**.

Display device **212** provides a mechanism to display data to a user and may be, for example, a computer monitor or a smart phone display screen.

The programs described herein are identified based upon the application for which they are implemented in a specific embodiment of the invention. However, it should be appreciated that any particular program nomenclature herein is used merely for convenience, and thus the invention should not be limited to use solely in any specific application identified and/or implied by such nomenclature.

The descriptions of the various embodiments of the present invention have been presented for purposes of illustration, but are not intended to be exhaustive or limited to the embodiments disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the described embodiments. The terminology used herein was chosen to best explain the principles of the embodiments, the practical application or technical improvement over technologies found in the marketplace, or to enable others of ordinary skill in the art to understand the embodiments disclosed herein.

II. Example Embodiment

FIG. 2 shows flowchart **250** depicting a method according to the present invention. FIG. 3 shows template training program **300**, which performs at least some of the method operations of flowchart **250**. This method and associated software will now be discussed, over the course of the following paragraphs, with extensive reference to FIG. 2 (for the method operation blocks) and FIG. 3 (for the software blocks). In this example John is scanning a set of invoices for his records.

Processing starts at operation **S255**, where identify first form module (mod) **302** identifies a first form. A first form is sometimes also called a master template. In some embodiments of the present invention, identify first form mod **302** identifies a first form as an input. In this example, identify first form mod **302** identifies first form **400** (FIG. 4), an invoice from Stuart Apothecary, based on input from John. In some embodiments of the present invention, forms are stored in a repository, such as form storage **218**. In some embodiments of the present invention, identify first form mod **302** retrieves a trained template from form storage **218**. In some embodiments of the present invention, a trained template is a form for which fields and coordinates were previously determined. In some embodiments of the present invention, identify first form mod **302** retrieves a trained template from form storage **218** and processing proceeds to operation **S270** (omitting operation **S260** and operation **S265**). Identifying a first form is sometimes also called implementing a trained template. In some embodiments of the present invention, identify first form mod **302** identifies a first form at a run time. In some embodiments of the present invention, identify first form mod **302** identifies a first form based on a similarity to a second form.

Processing proceeds to operation **S260**, where determine field names mod **304** determines a set of field names corresponding to a set of fields. Fields are sometimes also called zones. Determining a set of field names corresponding to a set of fields is sometimes also called data extraction. In this example, determine field names mod **304** determines

field names for two fields: identified field **402**; and identified field **404**. In some embodiments of the present invention, determine field names mod **304** receives field names as an input. In some embodiments of the present invention, determine field names mod **304** determines a set of field names for all fields on a form. In some embodiments of the present invention, determine field names mod **304** determines field names for a set of preselected fields. In some embodiments of the present invention, determine field names mod **304** uses OCR to determine a set of field names. In some embodiments of the present invention, determine field names mod **304** uses zonal OCR to determine a set of field names.

Processing proceeds to operation **S265**, where determine coordinates mod **306** determines a set of coordinates for a set of fields. Determine coordinates mod **306** uses field names (identified by determine field names mod **304**) to determine coordinates for content of a field. Determine coordinates mod **306** can express coordinates of content in a variety of manners. In this example, determine coordinates mod **306** uses OCR to determine content of each identified field (i.e., the invoice date, Aug. 17, 2015, and the invoice number, 2041955). In this example, determine coordinates mod **306** uses content locations to determine coordinates of the content. In this example, determine coordinates mod **306** expresses coordinates in inches in a format {x-start, x-distance, y-start, y-distance}, where “x-start” represents the start of the content of a field with respect to an x-axis of a form and “x-distance” represents the length of the content with respect to the x-axis of the form. In this example, determine coordinates mod **306** determines coordinates of the invoice date for first form **400** are {6.25, 1.25, 2.53125, 0.25} and coordinates of the invoice number for first form **400** are {6.0625, 1.125, 2.875, 0.25}. In this example, first coordinates form **500** (FIG. 5) shows a screenshot of determine coordinates mod **306** determining a set of coordinates.

In some embodiments of the present invention, determine coordinates mod **306** determines coordinates for content of a set of fields received as an input. In some embodiments of the present invention, determine coordinates mod **306** determines coordinates for content of all fields on a form. In some embodiments of the present invention, determine coordinates mod **306** determines coordinates for content of a set of preselected fields. In some embodiments of the present invention, determine coordinates mod **306** uses OCR to locate content of a field on a form. In some embodiments of the present invention, determine coordinates mod **306** uses zonal OCR to locate content of a field on a form.

Processing proceeds to operation **S270**, where identify second form mod **308** identifies a second form. In some embodiments of the present invention, identify second form mod **308** identifies a second form as an input. In this example, identify second form mod **308** identifies second form **700** (FIG. 7), an invoice from Rapid Car Repair, based on input from John. In some embodiments of the present invention, identify second form mod **308** identifies a second form in form storage **218**.

Processing proceeds to operation **S275**, where superimpose mod **310** superimposes a set of fields on a second form. Superimposing a set of fields on a second form is sometimes also called applying a skin and/or mapping. Data extraction sometimes also includes superimposing a set of fields on a second form. Superimpose mod **310** superimposes a set of fields on a second form based, at least in part, on a set of coordinates. In this example, superimpose mod **310** superimposes a set of fields determined in operation **S260** on a second form determined in operation **S265** (second form

700), based, at least in part, on a set of coordinates determined in operation **S270** (identified field **502** and identified field **504**). In this example, masked form **800** (FIG. 8) shows a screenshot of superimpose mod **310** superimposing a set of fields on a second template. In some embodiments of the present invention, superimpose mod **310** uses a scaling factor to scale a set of coordinates based on dimensions of a first form and a second form. In some embodiments of the present invention, superimpose mod **310** initializes a set of fields. In some embodiments of the present invention, superimpose mod **310** initializes a set of fields corresponding to a set of fields of a first form. In some embodiments of the present invention, superimpose mod **310** superimposes a set of fields on a second form at a design time. In some embodiments of the present invention, superimpose mod **310** superimposes a set of fields on a second form at a design time, allowing a developer to train a new template. In some embodiments of the present invention, superimpose mod **310** superimposes a set of fields on a second form at a run time. In some embodiments of the present invention, superimpose mod **310** superimposes a set of fields on a second form at a run time, allowing a template training sub-system to create a new template at a run time.

Processing proceeds to operation **S280**, where adjust coordinates mod **312** adjusts coordinates of a set of fields superimposed on a second form. Adjusting coordinates is sometimes also called offsetting or generating a second set of coordinates. Adjust coordinates mod **312** determines that coordinates of a field superimposed on a second form do not align with a location of a corresponding field on the second form. In some embodiments of the present invention, adjust coordinates mod **312** determines that a set of field names on a second form are synonyms of a set of field names on a first form. In some embodiments of the present invention, adjust coordinates mod **312** uses a thesaurus to determine that field names on various forms are synonyms. Adjust coordinates mod **312** adjusts coordinates of a field superimposed on a second form. In this example, adjust coordinates mod **312** uses OCR to determine coordinates for locations of identified field **702** and identified field **704** and adjusts coordinates of fields superimposed on second form **700** (resulting in adjusted field **902** and adjusted field **904**). Alternatively, adjust coordinates mod **312** uses zonal OCR to determine coordinates for locations of identified field **702** and identified field **704**. Adjust coordinates mod **312** can express coordinates of content in a variety of manners. In some embodiments of the present invention, an offset is identified. In some embodiments of the present invention, an offset is zero. In some embodiments of the present invention, an offset represents a change in a pixel location for a set of coordinates. In some embodiments of the present invention, an offset represents a change in one or more coordinates in a set of coordinates. In some embodiments of the present invention, adjust coordinates mod **312** uses image processing techniques to adjust coordinates of a field on a second form. In some embodiments of the present invention, adjust coordinates mod **312** uses image processing techniques at a runtime. In some embodiments of the present invention, image processing techniques include, but are not limited to: (i) locating a keyword; and/or (ii) locating a value near a keyword. In some embodiments of the present invention, adjust coordinates mod **312** adjusts coordinates of a set of fields superimposed on a second form at a verification time.

In this example, adjust coordinates mod **312** uses OCR to determine content of each identified field (i.e., the invoice date, Feb. 26, 2015, and the invoice number, 70002). In this example, adjust coordinates mod **312** uses content locations

to determine coordinates of the content. In this example, adjust coordinates mod 312 adjusts coordinates of superimposed field 802 and superimposed field 804 to create adjusted field 902 and adjusted field 904. In this example, adjust coordinates mod 312 determines coordinates of the invoice date for second form 700 are {6.0625, 1.125, 2.875, 0.25} and coordinates of the invoice number for second form 700 are {7.375, 1.09375, 1.1875, 0.25}. In this example, adjust coordinates mod 312 adjusts coordinates of superimposed field 802 and superimposed field 804 to match the coordinates of the identified fields. In this example, second coordinates form 900 (FIG. 9) shows a screenshot of adjust coordinates mod 312 adjusting a set of coordinates. Data extraction sometimes also includes extracting data within a set of coordinates on a second form.

Processing proceeds to operation S285, where receive mod 314 receives a set of adjustments of a set of fields. Adjustment of a set of fields is sometimes also called refinement. In some embodiments of the present invention, processing omits operations S285 and proceeds from operation S280 to operation S290. In some embodiments of the present invention, receive mod 314 receives a set of manual adjustments of a set of fields. In some embodiments of the present invention, receive mod 314 receives a set of automated adjustments of a set of fields. Receive mod 314 generally receives fine adjustments to a set of coordinates (e.g., fine tuning). For example, the invoice date identified by adjusted field 902 follows a colon; if adjust coordinates mod 312 had included the colon as part of adjusted field 902, receive mod 314 would receive an adjustment manipulating adjusted field 902 so as not to include the colon. In some embodiments of the present invention, receive mod 314 receives a set of adjustments through a graphical user interface. Alternatively, receive mod 314 receives a set of adjustments as an input of a modified set of coordinates. In some embodiments of the present invention, receive mod 314 receives a set of adjustments of a set of fields at a verification time.

Processing terminates at operation S290, where store mod 316 stores a second form. A stored second form is sometimes also called a trained template. In some embodiments of the present invention, store mod 316 stores a second form in a repository. In this example, store mod 316 stores second coordinates form 900 in form storage 218. In some embodiments of the present invention, store mod 316 stores a second form as a form with a set of identified fields. Alternatively, store mod 316 stores a second form as a set of identified fields on a blank form. A set of identified fields on a blank form is sometimes also called a form skin. For example, store mod 316 could store form skin 600 as a second form. In further alternative embodiments, store mod 316 stores a set of coordinates for a set of identified fields as a second form. In some embodiments of the present invention, store mod 316 stores a set of coordinates as a table.

III. Further Comments and/or Embodiments

Some embodiments of the present invention recognize the following facts, potential problems, and/or potential areas for improvement with respect to the current state of the art: (i) zonal OCR generally requires a new template for each document; and/or (ii) manual creation of a new template for each form is time and labor intensive.

FIG. 4 depicts a screenshot of first form 400. First form 400 is an invoice from Stuart Apothecary. First form 400 contains various zones (sometimes also called fields), including: identified field 402; and identified field 404.

Identified field 402 shows an invoice date of Aug. 17, 2015 (8/17/2015). Identified field 404 shows an invoice number of 2041955.

FIG. 5 depicts a screenshot of first coordinates form 500. First coordinates form 500 is first form 400 with a set of identified fields. First coordinates form 500 includes: identified field 502; and identified field 504. Identified field 502 and identified field 504 are each represented by a dashed line surrounding the identified field. In some embodiments of the present invention, a template training sub-system identifies an identified field by a set of coordinates. In some embodiments of the present invention, a template training sub-system identifies an identified field by a set of dimensions. In some embodiments of the present invention, a template training sub-system identifies a set of dimensions in pixels. In some embodiments of the present invention, a template training sub-system identifies a set of dimensions in inches. Alternatively, a template training sub-system identifies a set of dimensions in various units of measurement. In some embodiments of the present invention, a template training sub-system identifies an identified field in the format, {x-start, y-start, x-end, y-end}. In some embodiments of the present invention, a template training sub-system identifies an identified field in the format, {x-start, x-distance, y-start, y-distance}. In this example, the template training sub-system identifies the set of identified fields in the format {x-start, x-distance, y-start, y-distance}, wherein each value is measured in inches, as displayed in Table 1, below.

TABLE 1

Identified Fields.		
Fields	Field Names	Field Coordinates
Identified Field 502	Invoice Date	{6.25, 1.25, 2.53125, 0.25}
Identified Field 504	Invoice Number	{6.0625, 1.125, 2.875, 0.25}

FIG. 6 depicts a screenshot of form skin 600. Form skin 600 is an application of a set of identified fields to a blank template. Form skin 600 contains: identified field 602; and identified field 604. In this example, identified field 602 has the same field coordinates relative to form skin 600 as identified field 502 has relative to first coordinates form 500. Additionally, identified field 604 has the same field coordinates relative to form skin 600 as identified field 504 has relative to first coordinates form 500.

FIG. 7 depicts a screenshot of second form 700. Second form 700 is an invoice from Rapid Car Repair. Second form 700 contains various zones (sometimes also called fields), including: identified field 702; and identified field 704. Identified field 702 shows an invoice date of Feb. 26, 2015 (02/26/15). Identified field 704 shows an invoice number of 70002. In this example, first form 400 and second form 700 display a variability among forms, specifically with respect to the locations of fields for an invoice date and an invoice number.

FIG. 8 depicts a screenshot of masked form 800. Masked form 800 is an overlay of form skin 600 on second form 700. Masked form 800 contains: superimposed field 802; and superimposed field 804. In this example, superimposed field 802 has the same field coordinates relative to masked form 800 as identified field 502 has relative to first coordinates form 500. Additionally, superimposed field 804 has the same field coordinates relative to masked form 800 as identified field 504 has relative to first coordinates form 500. However, superimposed field 802 is not located around a field related to an invoice date. Additionally, superimposed field 804 is

not located around a field related to an invoice number. Because superimposed field **802** and superimposed field **804** are not located around appropriate fields on masked form **800**, adjustment to the locations of superimposed field **802** and superimposed field **804** are required.

FIG. **9** depicts a screenshot of second coordinates form **900**. Second coordinates form **900** is masked form **800** with adjustments made to a set of identified fields, shown as adjusted field **902** and adjusted field **904**. A template training sub-system adjusts the location of each of the two identified fields (adjusted field **902** and adjusted field **904**) to properly locate the desired fields. In this example, a template training sub-system adjusts adjusted field **902** to locate an invoice date on second coordinates form **900** and adjusts adjusted field **904** to locate an invoice number on second coordinates form **900**. In some embodiments of the present invention, a template training sub-system uses OCR to locate a field name on a form. In some embodiments of the present invention, a template training sub-system uses zonal OCR to locate a field name on a form. For example, first form **400** and second form **700** each have a field named "Invoice Date"; a template training sub-system can locate each of these field names using OCR techniques. Responsive to determining that the field names from first form **400** and second form **700** correspond, a template training sub-system can adjust a location for adjusted field **902** on second coordinates form **900** to properly identify an invoice date.

However, identified field **404** and identified field **704** have different field names. Identified field **404** appears as "Invoice No.," while identified field **704** appears as "Invoice #." Additionally, other variations of this field name are used, including "Invoice Number." In some embodiments of the present invention, a template training sub-system includes a thesaurus (sometimes also called a key file) including various field names and potential alternatives. In some embodiments of the present invention, a template training sub-system includes a thesaurus for abbreviations (e.g., number and no.). In some embodiments of the present invention, a template training sub-system includes a thesaurus for various regional spellings (e.g., color and colour). In some embodiments of the present invention, a template training sub-system includes a thesaurus for various misspellings (e.g., number and nomber). In some embodiments of the present invention, a template training sub-system includes a thesaurus for symbolic representations of words (e.g., number and #). In this example, a template training sub-system determines that "Invoice No." on first form **400** and "Invoice #" on second form **700** represent corresponding fields on different forms. Responsive to determining that the field names from first form **400** and second form **700** correspond, a template training sub-system can adjust a location for adjusted field **904** on second coordinates form **900** to properly identify an invoice number. In some embodiments of the present invention, a template training sub-system includes a thesaurus for various formatting of a field (e.g., date formatting: M/D/YY; MM/DD/YY; DD/MM/YYYY; Month Day, Year; Day Month Year; etc.). In this example, a template training sub-system determines coordinates for adjusted field **902** and adjusted field **904** as displayed in Table 2, below.

TABLE 2

Adjusted Fields.		
Fields	Field Names	Field Coordinates
Adjusted Field 902	Invoice Date	{6.0625, 1.125, 2.875, 0.25}
Adjusted Field 904	Invoice Number	{7.375, 1.09375, 1.1875, 0.25}

Some embodiments of the present invention may include one, or more, of the following features, characteristics, and/or advantages: (i) training a new image template based on an automatic recognition of a set of fields; (ii) refining a set of fields in a new template based, at least in part, on an image processing technique (also sometimes called an edge detection technique); (iii) improving an identification of a set of fields; (iv) creating a finger print template for a set of input images; and/or (v) improving conventional zonal OCR techniques.

Some embodiments of the present invention may include one, or more, of the following features, characteristics, and/or advantages: (i) creating a set of image templates; (ii) identifying a set of fields; (iii) automating a creation of a set of image templates; (iv) automating an identification of a set of fields; (v) employing image capture techniques to a set of forms; and/or (vi) employing enterprise content management to a set of image templates.

Some embodiments of the present invention may include one, or more, of the following features, characteristics, and/or advantages: (i) creating a new template based, at least in part, on a set of existing templates; (ii) creating a set of field definitions in a new template based, at least in part, on a set of field definitions in a set of existing templates; (iii) aligning a set of field definitions on a new template based on image processing; and/or (iv) superimposing a set of field definitions on a new template based on image processing.

Some embodiments of the present invention may include one, or more, of the following features, characteristics, and/or advantages: (i) superimposing a set of fields from a first template to a second template; (ii) superimposing a set of fields at a runtime; (iii) training a new template; (iv) using an automatic process to train a new template; (v) correcting a new template; and/or (vi) using an automatic process to correct a new template.

Some embodiments of the present invention may include one, or more, of the following features, characteristics, and/or advantages: (i) superimposing a set of fields from a first image to a second image; (ii) applying a superimposition of a set of fields at a runtime; and/or (iii) training an image template.

Some embodiments of the present invention may include one, or more, of the following features, characteristics, and/or advantages: (i) adjusting a field offset based, at least in part, on image processing; and/or (ii) using an automatic process to adjust a field offset based, at least in part, on image processing.

Some embodiments of the present invention may include one, or more, of the following features, characteristics, and/or advantages: (i) creating a set of image templates; (ii) creating a set of image templates by reading a first template and superimposing the first template on a received image; (iii) refining a new template; (iv) creating a fingerprint of a received image through the use of a template; and/or (v) creating a new template and a set of field definitions automatically.

Some embodiments of the present invention may include one, or more, of the following features, characteristics, and/or advantages: (i) decreasing delays caused by manual creation of a new template; (ii) increasing throughput of new templates; (iii) automating the creation of mapping a template to a new form; (iv) decreasing a likelihood of encountering human errors; (v) decreasing a time required to manually adjust a set of coordinates for a field; (vi) creating a field at a run time; and/or (vii) adjusting a field at a design time.

IV. Definitions

"Present invention" does not create an absolute indication and/or implication that the described subject matter is cov-

ered by the initial set of claims, as filed, by any as-amended set of claims drafted during prosecution, and/or by the final set of claims allowed through patent prosecution and included in the issued patent. The term “present invention” is used to assist in indicating a portion or multiple portions of the disclosure that might possibly include an advancement or multiple advancements over the state of the art. This understanding of the term “present invention” and the indications and/or implications thereof are tentative and provisional and are subject to change during the course of patent prosecution as relevant information is developed and as the claims may be amended.

“Embodiment,” see the definition for “present invention.”

“And/or” is the inclusive disjunction, also known as the logical disjunction and commonly known as the “inclusive or.” For example, the phrase “A, B, and/or C,” means that at least one of A or B or C is true; and “A, B, and/or C” is only false if each of A and B and C is false.

A “set of” items means there exists one or more items; there must exist at least one item, but there can also be two, three, or more items. A “subset of” items means there exists one or more items within a grouping of items that contain a common characteristic.

A “plurality of” items means there exists at more than one item; there must exist at least two items, but there can also be three, four, or more items.

“Includes” and any variants (e.g., including, include, etc.) means, unless explicitly noted otherwise, “includes, but is not necessarily limited to.”

A “user” or a “subscriber” includes, but is not necessarily limited to: (i) a single individual human; (ii) an artificial intelligence entity with sufficient intelligence to act in the place of a single individual human or more than one human; (iii) a business entity for which actions are being taken by a single individual human or more than one human; and/or (iv) a combination of any one or more related “users” or “subscribers” acting as a single “user” or “subscriber.”

The terms “receive,” “provide,” “send,” “input,” “output,” and “report” should not be taken to indicate or imply, unless otherwise explicitly specified: (i) any particular degree of directness with respect to the relationship between an object and a subject; and/or (ii) a presence or absence of a set of intermediate components, intermediate actions, and/or things interposed between an object and a subject.

A “module” is any set of hardware, firmware, and/or software that operatively works to do a function, without regard to whether the module is: (i) in a single local proximity; (ii) distributed over a wide area; (iii) in a single proximity within a larger piece of software code; (iv) located within a single piece of software code; (v) located in a single storage device, memory, or medium; (vi) mechanically connected; (vii) electrically connected; and/or (viii) connected in data communication. A “sub-module” is a “module” within a “module.”

A “computer” is any device with significant data processing and/or machine readable instruction reading capabilities including, but not necessarily limited to: desktop computers; mainframe computers; laptop computers; field-programmable gate array (FPGA) based devices; smart phones; personal digital assistants (PDAs); body-mounted or inserted computers; embedded device style computers; and/or application-specific integrated circuit (ASIC) based devices.

“Electrically connected” means either indirectly electrically connected such that intervening elements are present or directly electrically connected. An “electrical connection”

may include, but need not be limited to, elements such as capacitors, inductors, transformers, vacuum tubes, and the like.

“Mechanically connected” means either indirect mechanical connections made through intermediate components or direct mechanical connections. “Mechanically connected” includes rigid mechanical connections as well as mechanical connection that allows for relative motion between the mechanically connected components. “Mechanically connected” includes, but is not limited to: welded connections; solder connections; connections by fasteners (e.g., nails, bolts, screws, nuts, hook-and-loop fasteners, knots, rivets, quick-release connections, latches, and/or magnetic connections); force fit connections; friction fit connections; connections secured by engagement caused by gravitational forces; pivoting or rotatable connections; and/or slidable mechanical connections.

A “data communication” includes, but is not necessarily limited to, any sort of data communication scheme now known or to be developed in the future. “Data communications” include, but are not necessarily limited to: wireless communication; wired communication; and/or communication routes that have wireless and wired portions. A “data communication” is not necessarily limited to: (i) direct data communication; (ii) indirect data communication; and/or (iii) data communication where the format, packetization status, medium, encryption status, and/or protocol remains constant over the entire course of the data communication.

The phrase “without substantial human intervention” means a process that occurs automatically (often by operation of machine logic, such as software) with little or no human input. Some examples that involve “no substantial human intervention” include: (i) a computer is performing complex processing and a human switches the computer to an alternative power supply due to an outage of grid power so that processing continues uninterrupted; (ii) a computer is about to perform resource intensive processing and a human confirms that the resource-intensive processing should indeed be undertaken (in this case, the process of confirmation, considered in isolation, is with substantial human intervention, but the resource intensive processing does not include any substantial human intervention, notwithstanding the simple yes-no style confirmation required to be made by a human); and (iii) using machine logic, a computer has made a weighty decision (for example, a decision to ground all airplanes in anticipation of bad weather), but, before implementing the weighty decision the computer must obtain simple yes-no style confirmation from a human source.

“Automatically” means “without any human intervention.”

The term “real time” includes any time frame of sufficiently short duration as to provide reasonable response time for information processing as described. Additionally, the term “real time” includes what is commonly termed “near real time,” generally any time frame of sufficiently short duration as to provide reasonable response time for on-demand information processing as described (e.g., within a portion of a second or within a few seconds). These terms, while difficult to precisely define, are well understood by those skilled in the art.

What is claimed is:

1. A method comprising:

- identifying, on a first form, a first field name corresponding to a first field;
- identifying, within the first field, first content, the first content having a first length;

15

determining a first set of coordinates for the first field, the first set of coordinates including the first length;
generating a first template based, at least in part, on the first set of coordinates, the first template including a first template field corresponding to the first field; 5
applying the first template to a second form having a second field name;
determining the first template field of the first template is not proximate the second field name of the second form; 10
generating a second template having a second template field by, with reference to the first template, locating the first template field proximate the second field name, the second form including a second content associated with the second field name, the second content located in a second field proximate the second field name, the second content having a second length; and 15
generating a second set of coordinates for the second template field including the second length; 20
wherein:
at least determining the first set of coordinates for the set of first fields on the first form is performed by computer software running on computer hardware.
2. The method of claim 1, further comprising: 25
receiving a set of adjustments for the second template field;
wherein:
adjusting the second template field is further based, at least in part, on the set of adjustments. 30
3. The method of claim 2, wherein the set of adjustments include a manual adjustment to be made by a user.
4. The method of claim 1, further comprising:
displaying the second template.
5. The method of claim 1, wherein superimposing the first 35
template on the second form is performed at a runtime.
6. The method of claim 1, further comprising:
storing the second template.
7. The method of claim 1, further comprising:
identifying, on the second form, the second field name 40
corresponding to the second field; and
determining that the second field name is synonymous to the first field name.
8. A computer program product comprising:
a computer readable storage medium having stored 45
thereon:
first instructions executable by a device to cause the device to identify, on a first form, a first field name corresponding to a first field;
sixth instructions executable by the device to cause the 50
device to identify, within the first field, first content, the first content having a first length;
second instructions executable by the device to cause the device to determine a first set of coordinates for the first field, the first set of coordinates including the 55
first length;
third instructions executable by the device to cause the device to generate a first template based, at least in part, on the first set of coordinates and, the first template including a first template field correspond- 60
ing to the first field;
fourth instructions executable by the device to cause the device to apply the first template to a second form having a second field name;
seventh instruction executable by the device to deter- 65
mine the first template field of the first template is not proximate the second field name of the second form;

16

ninth instructions executable by the device to cause the device to generate a second template having a second template field by, with reference to the first template, locating the first template field proximate the second field name, the second form including a second content associated with the second field name, the second content located in a second field proximate the second field name, the second content having a second length; and
fifth instructions executable by the device to cause the device to generate a second set of coordinates for the second template field including the second length.
9. The computer program product of claim 8, further comprising:
eighth instructions executable by the device to cause the device to receive a set of adjustments to the second set of coordinates for the second template field;
wherein:
adjusting the second template field is further based, at least in part, on the set of adjustments.
10. The computer program product of claim 9, wherein the set of adjustments include a manual adjustment to be made by a user.
11. The computer program product of claim 8, further comprising:
eighth instructions executable by the device to cause the device to display the second template.
12. The computer program product of claim 8, wherein superimposing the first template on the second form is performed at a runtime.
13. The computer program product of claim 8, further comprising:
eighth instructions executable by the device to cause the device to store the second form.
14. The computer program product of claim 8, further comprising:
eight instructions executable by the device to cause the device to identify, on the second form, the second field name corresponding to the second field; and
tenth instructions executable by the device to cause the device to determine that the second field name is synonymous to the first field name.
15. A computer system comprising:
a processor set; and
a computer readable storage medium;
wherein:
the processor set is structured, located, connected, and/or programmed to execute instructions stored on the computer readable storage medium; and
the instructions include:
first instructions executable by a device to cause the device to identify, on a first form, a first field name corresponding to a first field;
sixth instructions executable by the device to cause the device to identify, within the first field, first content, the first content having a first length;
second instructions executable by the device to cause the device to determine a first set of coordinates for the first field, the first set of coordinates including the first length;
third instructions executable by the device to cause the device to generate a first template based, at

17

least in part, on the first set of coordinates and, the first template including a first template field corresponding to the first field;

fourth instructions executable by the device to cause the device to apply the first template to a second form having a second field name;

seventh instruction executable by the device to determine the first template field of the first template is not proximate the second field name of the second form;

ninth instructions executable by the device to cause the device to generate a second template having a second template field by, with reference to the first template, locating the first template field proximate the second field name, the second form including a second content associated with the second field name, the second content located in a second field proximate the second field name, the second content having a second length; and

fifth instructions executable by the device to cause the device to generate a second set of coordinates for the second template field including the second length.

18

16. The computer system of claim **15**, further comprising: eighth instructions executable by the device to cause the device to receive a set of adjustments to the second set of coordinates for the second template field;

wherein:
 adjusting the second template field is further based, at least in part, on the set of adjustments.

17. The computer system of claim **15**, further comprising: eighth instructions executable by the device to cause the device to display the second template.

18. The computer system of claim **15**, wherein the first template on the second form is performed at a runtime.

19. The computer system of claim **16**, wherein the set of adjustments include a manual adjustment to be made by a user.

20. The computer system of claim **15**, further comprising: eight instructions executable by the device to cause the device to identify, on the second form, the second field name corresponding to the second field; and tenth instructions executable by the device to cause the device to determine that the second field name is synonymous to the first field name.

* * * * *